Grain Boundary Engineering for Assessing Durability and Aging Issues with Nickel-Based Superalloys, Phase I

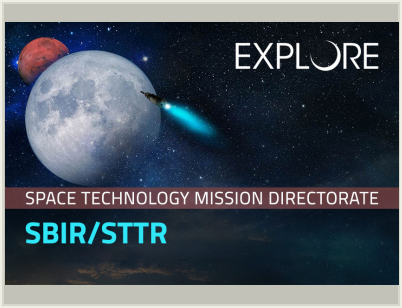
Completed Technology Project (2007 - 2007)

Project Introduction

Integran Technologies USA Inc.(Pittsburgh, PA) is pleased to provide this proposal in response to the Small Business Innovation Research (SBIR) Request for Proposal (RFP) (#A1.03), "Aircraft Aging and Durability". A material characterization technology is proposed that is based on grain boundary structure-property relationship to improve prediction of component life for nickel based superalloys. Since it has been well documented that the resistance to intergranular degradation is a function of the special (i.e., structurally ordered low- grain boundaries) grain boundary content in the material, the improvement in bulk material performance can be achieved through careful manipulation of the processing parameters to increase the presence of these special interfaces. The proposed program builds upon results of previous proprietary developments by the applicant in the areas of the microstructural optimization via metallurgical thermo-mechanical processing and the developed modeling concept based on grain boundary structure assessment. The program will involve material synthesis, testing and characterization activities with a specific emphasis on correlating the materials performance with respect to the grain boundary microstructure. The objective for this phase I program is to establish the inter-relationship amongst material processing, grain boundary character distribution, corrosion and deformation behaviour of the material. As a result of significant advances already made in the development of grain boundary engineering, the program proposed herein is expected to have a high probability of success and can potentially lead to a cost-effective technology for mitigating the susceptibility to microstructural instability and corrosion associated with Ni-based superalloys. This program is expected to require six (6) months for completion at a total cost of $100,000.

Anticipated Benefits

Application of the proposed GBE technology beyond that specified in this proposal include circumstances where superior corrosion resistance in required when the materials fail through a intergranular corrosion mechanism. Industries that may benefit from this technology which will alleviate and mitigate these intergranular degradation concerns include: Nuclear plant components (Intergranular corrosion, intergranular stress corrosion cracking) Pulp and paper recovery boiler components (thermal fatigue and environmental-assisted stress corrosion cracking) Lead acid battery industry (intergranular corrosion, intergranular stress corrosion cracking) Industrial power and energy plant components (sulfidation resistance) Enhancement of super alloys currently employed in aerostructures.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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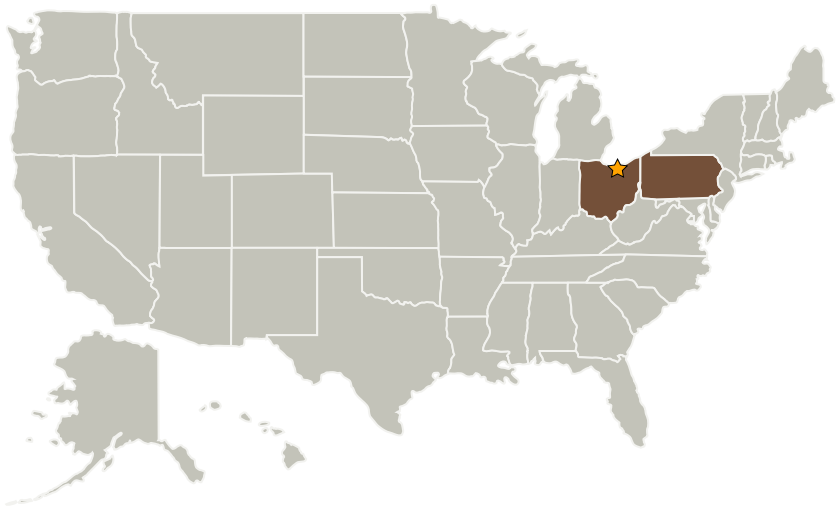
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Integran Technologies USA, Inc.	Supporting Organization	Industry	Pittsburgh, Pennsylvania

Primary U.S. Work Locations	
Ohio	Pennsylvania

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Timothy P Gabb

Principal Investigator:
Virgil Provenzano

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines